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Original article

Prevalence of chronic kidney disease and associated risk factors in patients with Type 2 Diabetes Mellitus in Basrah, Iraq: A cross-sectional study

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ABSTRACT

Aims: Chronic kidney disease (CKD) in patients with type 2 diabetes mellitus (T2DM) is underdiagnosed. We aimed to evaluate the prevalence of undiagnosed CKD in patients with T2DM and identify factors associated with increased prevalence of CKD.

Methods: This cross-sectional study included patients with T2DM presenting for their visit to two centers in Basrah, Southern Iraq. CKD was diagnosed based on the measurement of estimated glomerular filtration rate (eGFR) and urine albumin creatinine ratio (UACR). The association of the patients' demographic and biochemical characteristics with CKD was analyzed using logistic regression analysis.

Results: Among 1779 patients (mean age 55.0 ± 11.5 years, 39.0% male, mean T2DM duration 8.9 ± 6.9years), CKD was diagnosed in 887 (49.9%) patients. Specifically, 13.4% had eGFR <60 mL/min/1.73 $m^2$and 45.4% had UACR ≥30 mg/g. Independent predictors of CKD included increasing age (OR 1.03,95% CI 1.02–1.04), longer T2DM duration (OR 1.03, 95% CI 1.01–1.04), elevated HbA1c (OR 1.1, 95% CI1.09–1.19), higher total cholesterol (OR 1.008, 95% CI 1.003–1.01), uncontrolled hypertension (OR 1.4,95% CI 1.03–2.10), and lower HDL cholesterol (OR 0.9, 95% CI 0.9–0.99).

Conclusions: CKD was highly prevalent, affecting almost half of the patients with T2DM. Our findings highlighted the multiple risk factors associated with CKD and emphasized the importance of active CKD screening and comprehensive management strategies.

1. Introduction

The prevalence of type 2 diabetes mellitus (T2DM) in Iraq is considered high as it affects one out of every five adult persons [1]. T2DM is characterized by its insidious onset with mild symptoms, often remain undiagnosed. In many cases, diagnosis occurs after developing chronic complications. These complications are diabetic nephropathy, diabetic retinopathy, diabetic neuropathy, and cardiovascular diseases [2].

Diabetic nephropathy develops through complex pathophysiological mechanisms. Chronic hyperglycemia is the primary driver of chronic kidney disease (CKD) in T2DM [3], triggering metabolic, hemodynamic, inflammatory, and fibrotic pathways that, together with oxidative stress, lead to progressive kidney injury [4]. CKD is defined as abnormal kidney structure or function, present for a minimum of 3 months, and classified according to albuminuria and glomerular filtration rate (GFR) [5].

Globally, CKD affects over 850 million individuals. DM is the leading cause of advanced CKD worldwide. Moreover, DM is the main risk factor for CKD development in the Western countries where DM is present in 30 % – 50 % of CKD patients [6,7].

Early diagnosis of CKD is crucial for early intervention and prevention of disease progression to end-stage kidney disease (ESKD) [8]. The declining of estimated GFR (eGFR) and elevated urine albumin creatinine ratio (UACR) are independent risk factors for all-cause and cardiovascular mortality [9]. Thus, a consensus report from the American Diabetes Association (ADA) and Kidney Disease Improving Global Outcomes (KDIGO) recommends that patients with T2DM undergo CKD screening annually and at the time of diagnosis [9]. The most common old argument against screening was the lack of effective new glucose lowering therapies that can reverse the deterioration in kidney function.

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However, recent studies demonstrated that sodium glucose co-transporter 2 inhibitors and glucagon-like peptide-1 receptors agonists reduce the risk of ESKD [10].

Despite the development of clinical guidelines and treatment options, CKD remains significantly underdiagnosed and undertreated. In addition, awareness of CKD among healthcare professionals and health authorities is generally insufficient. Patients with T2DM remain unaware of CKD because of the asymptomatic presentation of early disease. Additionally, CKD often presents with multiple long-term conditions which complicate the detection and intervention by healthcare providers [11]. Despite the evolving knowledge of CKD pathophysiology, diagnosis, complications, and management in T2DM, less than half of the patients receive the recommended care [10].

In Iraq, limited data exist on CKD prevalence in T2DM populations. Previous studies from Southern Iraq (2009) and Kurdistan reported CKD prevalence of only 6.6 % and 14 % respectively [12,13], likely underestimating the true burden due to reliance on proteinuria alone or limited screening practices. Given the high T2DM prevalence in Iraq (affecting one in five adults) and the availability of kidney-protective therapies, updated data on CKD burden and associated risk factors are urgently needed to inform screening and management strategies

The objective of this study was to evaluate the prevalence of undiagnosed CKD in patients with T2DM and to identify factors associated with increased prevalence of CKD.

2. Subjects, materials, and methods

2.1. Study design

A cross-sectional study was conducted between July 2023 and November 2024 in two centers, in Basrah, Southern Iraq (Faiha Specialized Diabetes, Endocrine, and Metabolism Center [FDEMC] and Al-Rafidain Specialized Center). The study included patients with T2DM who presented to the centers for the first time for routine check-ups (those patients can be either newly diagnosed T2DM or having T2DM for years and came for their first time). Eligible participants included patients with established T2DM (previously diagnosed) or those meeting ADA diagnostic criteria during the study period [14]. Patients were enrolled consecutively during their first visit to either center during the study period. Additionally, participants with febrile illness, chronic liver disease, pregnancy, current menstruation, urinary tract infection, and recent hospitalization were excluded. This study adhered to the STROBE guidelines for reporting cross-sectional studies.

2.2. Clinical data

Body weight (kg) and height in meters (m) were measured for each patient with bare feet and light clothes. Body mass index (BMI) in (kg/m^2) was calculated; patients with BMI $\geq$30 kg/m^2 were classified as obese. Hypertension was confirmed in patients with a prior diagnosis who were receiving antihypertensive medication(s). Additionally, we measured the blood pressure using the fully Automatic Blood Pressure Monitor. Hypertension was also diagnosed if blood pressure measured $\geq$140/90 mmHg on two separate occasions [15]. Uncontrolled blood pressure was defined as systolic blood pressure (SBP) $\geq$140 mmHg or diastolic blood pressure (DBP) $\geq$90 mmHg.

2.3. Blood sampling

Blood samples were collected for biochemical analysis. Glycosylated hemoglobin (HbA1c) was measured by ion exchanges high-performance liquid chromatography using a Bio-Rad® D10. COBAS INTEGRA® 400 PLUS was used for the measurement of serum glucose, creatinine, total cholesterol (TC), triglyceride (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL). The equation of the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) was used to calculate eGFR which was reported as a mL/min/1.73 m^2 [16], and further categorized into G1 ($\geq$90), G2 (60 to 89), G3a (45 to 59), G3b (30 to 44), G4 (15 to 29), and G5 ($<$15) [17].

2.4. Urine sampling

Freshly voided urine samples were collected to measure urine albumin and creatinine using the COBAS INTEGRA® 400 PLUS. The UACR was calculated by dividing urine albumin in milligrams (mg) by urine creatinine in grams (g) and reported as (mg/g). A UACR of $<$10 was defined as normal. The UACR was further categorized as A1 ($<$30), A2 (30–300), and A3 ($>$300) [17]. Urine samples with white blood cells of two or more (per high power field), red blood cells, or positive nitrite reaction were excluded.

2.5. Statistical analysis

A subset of 98 newly diagnosed T2DM patients from this cohort was also included in a separate analysis focused on incidental CKD in newly diagnosed patients [18]. Continuous variables were tested for normality using the Kolmogorov-Smirnov test. Normally distributed variables are presented as mean $\pm$ standard deviation (SD), while non-normally distributed variables (if any) are presented as median (interquartile range). Categorical variables are presented as frequencies and percentages. Univariate analyses were first performed to identify potential predictors of CKD. Variables with $p < 0.10$ in univariate analysis were then entered into stepwise binary logistic regression models to identify independent predictors. Multicollinearity was assessed using variance inflation factors (VIF), with VIF$>$5 considered indicative of problematic collinearity. Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test.

Three separate stepwise binary logistic regression models were constructed to identify independent predictors of: 1) reduced eGFR ($<$60 mL/min/1.73 m^2), 2) elevated UACR ($\geq$30 mg/g), and 3) overall CKD (either condition). Variables entered into the models included age, gender, BMI, HbA1c, T2DM duration, hypertension, uncontrolled blood pressure, and lipid parameters (TC, TG, HDL, LDL). Results are presented as adjusted odds ratios with 95 % confidence intervals (CI). To account for multiple comparisons across three regression models, we used a conservative p-value threshold and emphasize effect sizes and confidence intervals alongside p-values.

Data were analyzed using the Statistical Package for the Social Sciences version 26.0. No formal sample size calculation was performed. Instead, we employed a comprehensive enrollment strategy, including all eligible patients presenting during the study period to maximize statistical power and representativeness.

2.6. Ethical considerations

The Iraqi Ministry of Health and the Institutional Review Board of the Faiha Specialized Diabetes, Endocrine, and Metabolism Center (FDEMC) of the Basrah Health Directorate approved the study (Reference number 31/12/23) in May 2023. A written informed consent was obtained from each patient.

3. Results

Overall, 1779 patients were included of whom 694 (39 %) were males. The mean age was 55.0 $\pm$ 11.5 years and 1008 (56.7 %) patients aged 55 years or older. Most patients (68.9 %) had T2DM duration $>$ 5 years (mean 8.9 $\pm$ 6.9 years). The mean of HbA1c at baseline was 9.4 $\pm$ 2.2 % (79 mmol/mol) and only 13.9 % had an HbA1c of $<$7 % (53 mmol/mol). Hypertension was diagnosed in 63.6 % of the patients. The mean of eGFR and UACR were 87.9 $\pm$ 23.5 mL/min/1.73 m^2 and 193.0 $\pm$ 683.7 mg/g, respectively (Table 1).

Overall, 887 (49.9 %) of the patients were diagnosed with CKD based

Table 1
Baseline characteristics of the study patients ($N = 1779$).

Variables	n (%) / mean ± SD
Age (years)	55.0 ± 11.5
Age ≥ 55 years	1008 (56.7)
Gender	
Male	694 (39.0)
Female	1085 (61.0)
BMI (kg/m^2)	31.1 ± 4.3
BMI ≥ 30	1196 (76.2)
T2DM duration (years)	8.9 ± 6.9
<5 years	554 (31.1)
5–10 years	676 (38.0)
>10 years	549 (30.9)
HbA1c (%)	9.4 ± 2.2
HbA1c <7 %*	248 (13.9)
FBG (mg/dL)	196.4 ± 88.5
RBG (mg/dL)	287.1 ± 132.6
TC (mg/dL)	191.7 ± 55.6
TG (mg/dL)	241.2 ± 178.3
HDL (mg/dL)	42.0 ± 12.4
LDL (mg/dL)	117.7 ± 43.1
SBP (mmHg)	142.4 ± 22.4
DBP (mmHg)	82.6 ± 13.9
Hypertension	1131 (63.6)
Uncontrolled SBP	901 (50.6)
Uncontrolled DBP	478 (26.9)
Uncontrolled BP	958 (53.9)
Urea (mg/dL)	39.1 ± 23.8
Creatinine (mg/dL)	0.87 ± 0.3
eGFR (mL/min/1.73 m^2)	87.9 ± 23.5
UACR (mg/g)	193.0 ± 683.7
GFR <60 mL/min/1.73 m^2	239 (13.4)

BMI: body mass index; DBP: diastolic blood pressure; eGFR: estimated glomerular filtration rate; FBG: fasting blood glucose; HbA1c: glycosylated hemoglobin; HDL: high-density lipoprotein; LDL: low-density lipoprotein; RBG: random blood glucose; SBP: systolic blood pressure; SD: standard deviation; TC: total cholesterol; TG: triglyceride; UACR: urine albumin-creatinine ratio.
* HbA1c available for 1760 patients.

on eGFR of <60 mL/min/1.73 m^2 and/or UACR of ≥ 30 mg/g (Fig. 1). Almost half of the patients had an eGFR of ≥90 mL/min/1.73 m^2 (55.3 %) or a UACR of < 30 mg/g (54.6 %) (Table 2). Table 2 presents a risk stratification matrix cross-tabulating eGFR and albuminuria categories. Using the KDIGO risk classification, 540 patients (30.3 %) were at low risk for adverse outcomes, 229 (12.8 %) at moderate risk, 103 (5.7 %) at high risk, and 15 (0.8 %) at very high risk for progressive CKD and cardiovascular complications.

Three separate stepwise binary logistic regression models were constructed to identify independent predictors of: (1) reduced eGFR (<60 mL/min/1.73 m^2), (2) elevated UACR (≥30 mg/g), and (3) overall CKD (either condition). Results are presented in Table 3. Increasing patient age, longer T2DM duration, increasing TC level, and decreasing HDL level were significantly associated with higher risk of having an eGFR <60 mL/min/1.73 m^2. Increasing age, increasing HbA1c level, longer T2DM duration, increasing TC level, uncontrolled hypertension, and decreasing HDL level were significantly associated with having a UACR of ≥ 30 mg/g and CKD (eGFR <60 mL/min/1.73 m^2 and/or UACR ≥30 mg/g).

4. Discussion

The objective of our study was to evaluate the prevalence of undiagnosed CKD in patients with T2DM and to identify factors associated with increased prevalence of CKD. This study showed a high prevalence of CKD (49.9 %) among patients with T2DM in Basrah, Iraq, substantially higher than the global average of 28 % and previous Iraqi estimates of 6.6–14 % [12,13]. Nearly half of our cohort exhibited either reduced eGFR, elevated albuminuria, or both, highlighting a significant gap in CKD detection and management in this population. Compared to other studies from the Middle East and worldwide, similar trends were observed highlighting the consistent prevalence of CKD in the T2DM population. For instance, the prevalence of CKD in patients with T2DM in the Middle East region ranged from 10.8 % to 60.78 %, with an overall pooled prevalence of 28.96 % [19]. A study conducted in Iran by Kheirandish et al. reported a prevalence of CKD of 29.6 % among patients with T2DM [20]. Similarly, the United Kingdom Prospective Diabetes Study (UKPDS) reported a CKD prevalence of 31 % among their diabetic cohort [21]. The substantially higher prevalence in our study compared to previous Iraqi reports [12,13] likely reflects more comprehensive screening (using both eGFR and UACR) rather than reliance on proteinuria alone, as well as potential increases in disease burden over time. This finding underscores the critical importance of systematic CKD screening using both markers in T2DM populations.

Regarding reduced eGFR level (<60 mL/min/1.73 m^2), our findings were in line with those reported by Afkarian et al. in the United States; 26.2 % of patients with T2DM were found to have impaired renal function [22]. Additionally, Matsushita et al. reported similar prevalence rates in their meta-analysis, indicating a global trend of this condition among patients with T2DM [23]. When comparing the prevalence of albuminuria, our study found that a significant proportion of the patients had elevated UACR levels. Worldwide studies supported this finding. In study from Pakistan, the prevalence of albuminuria was 30 % in patients with T2DM [24]. A Japanese study also confirmed the widespread occurrence of albuminuria in T2DM populations [25].

The analysis of factors associated with CKD in our study highlighted the significant contribution of several predictors. Our findings confirmed age and T2DM duration as powerful independent predictors of CKD, consistent with extensive prior evidence [26,27]. Each year of age increased CKD odds by 3 % (OR 1.03), while each additional year of diabetes increased odds by 3 % (OR 1.03). This cumulative effect underscores the importance of early diabetes diagnosis and intensive management to delay CKD onset. Furthermore, lipid abnormalities, such as elevated TC and reduced HDL, and hypertension (especially uncontrolled) were highlighted as significant risk factors in different studies [28–31]. Uncontrolled hypertension emerged as a significant risk factor (OR 1.4, $p = 0.03$), present in 53.9 % of patients. The high prevalence of both hypertension (63.6 %) and inadequate blood pressure control highlights the need for intensified cardiovascular risk factor management in this population [28–31]. Dyslipidemia significantly contributed to CKD risk, with elevated total cholesterol (OR 1.008 per mg/dL) and reduced HDL (OR 0.9 per mg/dL) serving as independent predictors. These findings support comprehensive lipid management as part of CKD prevention strategies [28,29]. Poor glycemic control, reflected by elevated HbA1c, was a strong independent predictor of CKD (OR 1.1 per 1 % increase). With a mean HbA1c of 9.4 ± 2.2 % (79 mmol/mol) and only13.9 % achieving target HbA1c <7 %, our cohort demonstrated substantial room for improvement in glycemic management. This finding aligns with landmark trials (UKPDS, ADVANCE) demonstrating that intensive glycemic control reduces nephropathy risk [21,32]. The consistency of these findings across different studies and regions demonstrates the multifactorial nature of CKD in patients with T2DM.

The current study highlighted that 30.3 %, 12.8 %, and 6.5 % had low, moderate, and high risk for future CKD and cardiovascular complications, respectively. When comparing these findings with published results, similar trends are observed. For instance, a study by Fox et al. [33] reported that a significant portion of the T2DM population falls into the low to moderate risk categories for future CKD and cardiovascular complications. Their study indicated that approximately 28 % of patients with T2DM had low risk, 15 % had moderate risk, and around 6 % had high risk for future renal and cardiovascular complications. Additionally, the study by Matsushita et al. [23] found that a similar distribution of risk categories existed among their study population. These findings indicate a similar risk profile among T2DM populations across different regions.

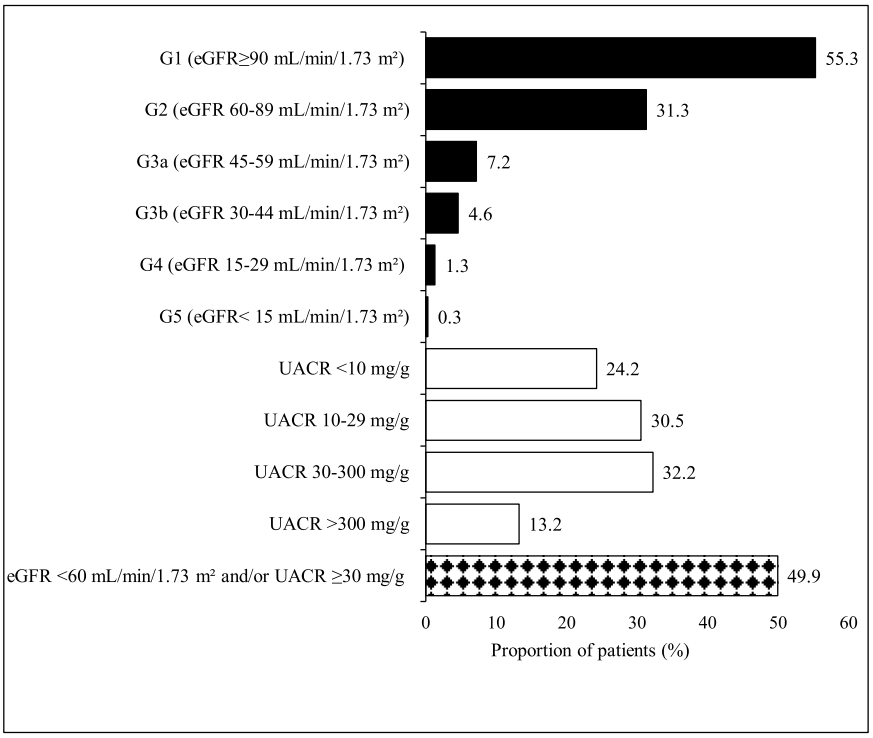

Fig. 1. Prevalences of different categories of estimated glomerular filtration rate and albuminuria ($N = 1779$).
T2DM: type 2 diabetes mellitus; eGFR: estimated glomerular filtration rate; UACR: urine albumin-creatinine ratio.
Shaded bar represents patients meeting CKD definition.

Table 2
The heat map for the future risk of cardiovascular and kidney complications (N 1779).

eGFR categories (mL/min/1.73 m^2)		Albuminuria categories A1 <30 mg/g	A2 30–300 mg/g	A3 >300 mg/g	Total
G1	**≥90**	572 (32.2)	324 (18.2) [a]	88 (4.9) [b]	984 (55.3)
G2	**60–89**	320 (18)	169 (9.5) [a]	67 (3.8) [b]	556 (31.3)
G3a	**45–59**	47 (2.6) [a]	46 (2.6) [b]	35 (2.0) [c]	128 (7.2)
G3b	**30–44**	28 (1.6) [b]	23 (1.3) [c]	31 (1.7) [c]	82 (4.6)
G4	**15–29**	4 (0.2) [c]	10 (0.5) [c]	10 (0.5) [d]	24 (1.3)
G5	**<15**	1 (0.05) [d]	1 (0.05) [d]	3 (0.2) [d]	5 (0.3)
Total		972 (54.6)	573 (32.2)	234 (13.2)	1779

eGFR: estimated glomerular filtration rate.
[a] : low risk.
[b] : moderate risk.
[c] : high risk.
[d] : very high risk.

This study has several strengths. The large sample size ($N = 1779$) from two centers enhances generalizability to the Iraqi T2DM population. Use of both eGFR and UACR enabled comprehensive CKD ascertainment according to current guidelines. The extensive assessment of demographic, clinical, and laboratory variables allowed multivariable risk factor analysis. Finally, the KDIGO risk stratification provides clinically actionable prognostic information. However, limitations must be acknowledged. First, the study enrolled patients presenting to specialized diabetes centers, who may differ from the broader T2DM population not engaged in regular care. This could result in either over estimation (sicker patients seek specialty care) or underestimation (healthiest patients not requiring specialist visits) of true community prevalence. Second, single measurements of eGFR and UACR were used, potentially overestimating true CKD prevalence. Third, we did not distinguish between diabetic kidney disease and CKD from other causes, though in T2DM the distinction is often unclear. Fourth, data on important risk factors (smoking, physical activity, medication use including renin-angiotensin system inhibitors) were not collected. The cross-sectional design precludes the establishment of causality and temporal relationships between risk factors and CKD development. Additionally, the study did not investigate the genetic and environmental factors influencing CKD susceptibility.

Our findings have important implications for diabetes care in Iraq and similar resource-limited settings. The 49.9 % CKD prevalence, with most cases previously undiagnosed, suggests that annual screening of all T2DM patients using both eGFR and UACR should be implemented as standard care, as recommended by ADA/KDIGO guidelines [9]. Our findings suggest that a comprehensive, multifactorial intervention strategy is needed with a timely use of kidney-protective therapies (SGLT2 inhibitors, GLP-1 receptor agonists) that may reduce ESKD risk [10]. Finally, the KDIGO risk stratification (Table 2) provides a practical framework for prioritizing resources toward the 19.3 % of patients at high or very high risk for adverse outcomes

In conclusion, this study revealed an alarmingly high prevalence of CKD (49.9 %) among patients with T2DM in Basrah, Iraq. The multifactorial nature of CKD, with independent contributions from age, diabetes duration, poor glycemic control, uncontrolled hypertension, and dyslipidemia, underscores the need for comprehensive risk factor management. Nearly one in five patients was classified as high or very high risk for progressive CKD and cardiovascular events, representing a population requiring intensive intervention. These findings highlight critical gaps in current diabetes care and emphasize the urgent need for systematic, CKD screening using both eGFR and UACR measurements. access to kidney-protective therapies, and intensifying multifactorial risk factor control to mitigate the substantial burden of CKD in the T2DM population.

Data availability

The Data that support the findings of this study are openly available

Table 3
Adjusted predictors for chronic kidney disease in patients with type 2 diabetes mellitus (N 1779).

Outcome	Predictors	SE	P-value	OR	95 % CI	
eGFR <60 mL/min/ 1.73 m^2	**Gender (men)**	0.1	0.9	0.9	0.7	1.37
	Age (years)	0.009	<0.0001	1.1	1.09	1.13
	BMI (kg/m^2)	0.01	0.1	0.9	0.9	1.008
	HbA1c (%)	0.03	0.6	1.01	0.9	1.09
	T2DM duration (years)	0.01	0.001	1.03	1.01	1.05
	Hypertension	0.2	0.08	1.6	0.9	2.74
	Uncontrolled BP	0.2	0.3	0.7	0.4	1.26
	TC (mg/dL)	0.003	0.001	1.01	1.004	1.016
	TG (mg/dL)	0.001	0.3	0.9	0.9	1.001
	HDL (mg/dL)	0.008	<0.0001	0.9	0.9	0.97
	LDL (mg/dL)	0.004	0.08	0.9	0.9	1.001
UACR ≥30 mg/g	**Gender (men)**	0.1	0.9	1.001	0.8	1.24
	Age (years)	0.005	<0.0001	1.02	1.01	1.03
	BMI (kg/m^2)	0.01	0.8	1.001	0.9	1.02
	HbA1c (%)	0.02	<0.0001	1.1	1.1	1.22
	T2DM duration (years)	0.008	0.001	1.02	1.01	1.04
	Hypertension	0.2	0.4	1.1	0.7	1.66
	Uncontrolled BP	0.1	0.01	1.5	1.07	2.19
	TC (mg/dL)	0.002	0.02	1.005	1.001	1.01
	TG (mg/dL)	0.0001	0.8	1.0	0.9	1.001
	HDL (mg/dL)	0.005	0.006	0.9	0.9	0.99
	LDL (mg/dL)	0.003	0.5	0.9	0.9	1.004
eGFR <60 mL/min/ 1.73 m^2 and/or UACR ≥30 mg/ g	**Gender (men)**	0.1	0.9	0.9	0.8	1.23
	Age (years)	0.005	0.0001	1.03	1.02	1.04
	BMI (kg/m^2)	0.01	0.2	0.9	0.9	1.01
	HbA1c (%)	0.02	<0.0001	1.1	1.09	1.19
	T2DM duration (years)	0.008	0.001	1.03	1.01	1.04
	Hypertension	0.1	0.4	1.1	0.8	1.69
	Uncontrolled BP	0.1	0.03	1.4	1.03	2.10
	TC (mg/dL)	0.003	0.003	1.008	1.003	1.01
	TG (mg/dL)	0.000	0.4	1.0	0.9	1.000
	HDL (mg/dL)	0.005	<0.0001	0.9	0.9	0.99
	LDL (mg/dL)	0.003	0.2	0.9	0.9	1.002

BMI: body mass index; BP: blood pressure; CI: confidence interval; eGFR: estimated glomerular filtration rate; HbA1c: glycosylated hemoglobin; HDL: high-density lipoprotein; LDL: low-density lipoprotein; OR: odds ratio; SE: standard error of the coefficient; TC: total cholesterol; TG: triglyceride; UACR: urine albumin-creatinine ratio.

in Figshare. Alidrisi, Haider (2025). dataset for CKD prevalence in type 2 diabetes.xlsx. figshare. Dataset. https://doi.org/10.6084/m9.figshare.28642319.v1

Ethical considerations

The Iraqi Ministry of Health and the Institutional Review Board of the Faiha Specialized Diabetes, Endocrine, and Metabolism Center (FDEMC) of the Basrah Health Directorate approved the study (Reference number 31/12/23) in May 2023. A written informed consent was obtained from each patient.

CRediT authorship contribution statement

Haider Ayad Alidrisi: Writing – review & editing, Validation, Project administration, Methodology, Formal analysis, Conceptualization. **Khulood Abed Reman:** Writing – review & editing, Validation, Methodology, Formal analysis, Conceptualization. **Emad Sakran Alhubaish:** Writing – review & editing, Validation, Methodology, Formal analysis, Conceptualization. **Ibrahim Hani Hussein:** Writing – review & editing, Validation, Methodology, Formal analysis, Conceptualization. **Hussein Ali Nwayyir:** Writing – review & editing, Validation, Methodology, Formal analysis, Conceptualization. **Ibrahim Abbood Zaboon:** Writing – review & editing, Validation, Methodology, Formal analysis, Conceptualization. **Musaab Ali Ashkar:** Writing – review & editing, Validation, Methodology, Formal analysis, Conceptualization. **Ali Hussain Alhamza:** Writing – review & editing, Validation, Methodology, Formal analysis, Conceptualization. **Abbas Ali Mansour:** Writing – review & editing, Validation, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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